REMARKS

Applicants gratefully acknowledge the indication by the Examiner that claim 4 would be allowable if rewritten in independent form. Applicants respectfully submit that claim 4 is rewritten in independent form; hence, claim 4 should be allowable.

Applicants respectfully submit that entry of this §1.116 Amendment is proper. Since the amendments above narrow the issues for appeal and merely clarify the subject matter of the claims. Applicants further respectfully submit that such amendments do not raise a new issue requiring a further search and/or consideration by the Examiner. As such, entry of this §1.116 Amendment is earnestly solicited.

Claims 1-7, 32, and 33 are pending in this application. This Amendment amends claims 1, 2, 4, 5, 7, 32 and 33. No new matter is added to amended claims 1, 2, 4, 5, 7, 32 and 33. Claims 1, 2, 4, 5, 7, 32 and 33 are amended to merely clarify the subject matter of the claims and in no way narrows the scope of the claims in order to overcome the prior art or for any other statutory purpose of patentability. Notwithstanding any claim amendments of the present Amendment or those amendments that may be made later during prosecution, Applicants' intent is to encompass equivalents of all claim elements. Reconsideration in view of the foregoing amendments and the following remarks is respectfully requested.

Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The attached pages are captioned "**Version with markings to show changes made**."

Claims 1, 5, and 7 stand rejected under 35 U.S.C. §102(b) as anticipated by JP 10-312971 to Sunakawa et al. (hereinafter, Sunakawa), which corresponds to U.S. Patent No. 6,348,096 to Sunakawa et al. (hereinafter, Sunakawa '096). Claims 2, 3, and 6 stand rejected under 35 U.S.C. §103(a) as unpatentable over Sunakawa in view of U.S. Patent No. 6,194,742 to Kern et al. (hereinafter, Kern). Claims 32 and 33 stand rejected under 35 U.S.C. §103(a) as unpatentable over WO99/20816 to Beaumont et al. (hereinafter, Beaumont), which corresponds to U.S. Patent No. 6,325,850 B1.

These rejections are respectfully traversed in view of the following discussion.

I. THE CLAIMED INVENTION

The claimed invention, as described in independent claim 1, discloses a group III nitride compound semiconductor device that includes a substrate having an upper surface, an undercoat layer formed directly on an entirety of the upper surface of the substrate, in which an upper surface of the undercoat layer is covered with convex portions, each of the convex portions being shaped like a truncated hexagonal pyramid, and group III nitride compound semiconductor layers formed on the undercoat layer and having a device function.

The claimed invention, as described in independent claim 32, discloses a group III nitride compound semiconductor device that includes a substrate having an upper surface, an undercoat layer formed directly on an entirety of the upper surface of the substrate, in which a cross-section of an upper surface of the undercoat layer is characterized by a sectionally trapezoid shape, and group III nitride compound semiconductor layers formed on the undercoat layer and having a device function.

An aspect of the present invention is the formation of an undercoat layer, under more efficient production conditions, that has a textured surface with flat regions and sloped regions on a sub-micron scale. Specifically, where the percentage of sloped regions, as measured by a percentage of area on a parallel plane projection of the textured surface, varies from 30% to 70%, the surface of the undercoat layer in cross-section will resemble a number of trapezoids. Hence, such an undercoat layer is called "a sectionally trapezoid shape." (Specification, page 11, line 15 to page 12, line 7). The upper surface of a sectionally trapezoid shaped undercoat layer, when viewed in perspective, will show a number of convex portions, each of the convex portions being shaped like a truncated hexagonal pyramid. (Specification, page 14; lines 18-20).

II. THE PRIOR ART REJECTIONS

A. The Sunakawa Reference

Figs. 1a of both Sunakawa and Sunakawa '096 disclose a substrate 11, a group III-V compound semiconductor film 12, a mask 14, and growing areas 13. Sunakawa also discloses that the mask 14, which is formed by photolithography and wet etch methods, forms restricted growth fields on the substrate [0024]. Sunakawa further discloses that the

configuration of the mask is that of stripes with the thickness of the mask being about 2 micrometers from 10nm and that the growth field 13 and the stripe width of the mask 14 were usually set to 0.1 to about 10 micrometers [0024].

Fig. 7(a-d) of Sunakawa '096, which corresponds to Fig. 6(a-d) of Sunakawa, shows that SiO_2 is produced on the surface of the substrate 61, and the surface of the substrate is separated into a first mask area 63 and first growing areas 64 (col. 11, lines 14-17). The first mask area 63 and first growing areas 62 are produced in the shape of stripes, where the width of the first mask area is 5 μm and the width of the first growing areas is 2 μm.

Claim 1 recites at least the features of "an undercoat layer formed directly on an entirety of said upper surface of said substrate, in which an upper surface of said undercoat layer is covered with convex portions, each of said convex portions being shaped like a truncated hexagonal pyramid."

The upper surface of the substrate of Sunakawa is covered in part by a mask 14, which divides the upper surface of the substrate into growing areas 34 for subsequent growth of a III-V compound semiconductor layer. In contrast, the present invention allows formation of the undercoat layer, corresponding to the III-V compound semiconductor layer of Sunakawa, on the entirety of the upper surface of the substrate without a mask layer. An obvious advantage of the present invention is the avoidance of depositing a mask layer and subsequently patterning the mask layer. Therefore, Sunakawa does not disclose, teach or suggest "an undercoat layer formed directly on an entirety of said upper surface of said substrate, in which an upper surface of said undercoat layer is covered with convex portions, each of said convex portions being shaped like a truncated hexagonal pyramid" as recited in claim 1.

In addition, the Office Action asserts that Sunakawa discloses "the undercoat layer having a surface with convex portions each shaped substantially like a truncated hexagonal pyramid (see Figs. 3(a)-(c))" (Office Action, page 2, lines 16-18). However, the facets 46 of Fig. 5 of Sunakawa are formed on GaN layer 45, which better corresponds to the claimed invention's group III nitride compound semiconductor layer, rather than layer GaN film layer 42 of Sunakawa, which better corresponds to the claimed invention's undercoat layer.

For at least the reasons outlined above, Applicant respectfully submits that Sunakawa

does not disclose, teach or suggest every feature of claim 1. Accordingly, Sunakawa does not anticipate, or render obvious, the subject matter of claim 1 and claims 5 and 7, which depend from claim 1. Withdrawal of the rejection of claims 1, 5, and 7 under 35 U.S.C. §102(b) as anticipated by Sunakawa is respectfully solicited.

B. The Kern Reference

Kern discloses an interfacial layer 16 (identified as the Mg-doped GaN undercoat layer (16) in the Office Action on page 3, line 17) that is deposited directly on top of a buffer layer 14 prior to growth of an n-type (GaN:Si) layer 18, an active region 10, and a p-type layer 22 (col. 3, lines 49-51 and Fig. 3).

Claim 1 recites at least the features of "an undercoat layer formed directly on an entirety of said upper surface of said substrate, in which an upper surface of said undercoat layer is covered with convex portions, each of said convex portions being shaped like a truncated hexagonal pyramid."

Kern does not cure the deficiencies of Sunakawa. The undercoat layer of the present invention is formed on the upper surface of the substrate. In contrast, the undercoat layer 16 of Kern is formed on the buffer or nucleation layer 14, which in turn is formed on the substrate 12. Therefore, Kern does not teach or suggest "an undercoat layer formed directly on an entirety of said upper surface of said substrate" as recited in claim 1.

Furthermore, nowhere does Kern teach or suggest that the upper surface of the interfacial layer 16, corresponding to the claimed invention's undercoat layer, "is covered with convex portions, each of said convex portions being shaped like a truncated hexagonal pyramid" as further recited in claim 1.

For at least the reasons outlined above, Applicant respectfully submits that Sunakawa and Kern either individually or in combination do not teach or suggest every feature of claim 1. Accordingly, Sunakawa and Kern either individually or in combination fail to render obvious the subject matter of claim 1 and claims 2, 3, and 6, which depend from claim 1 under 35 U.S.C. §103(a). Withdrawal of the rejection of claims 2, 3, and 6 under 35 U.S.C. §103(a) as unpatentable over Sunakawa in view of Kern is respectfully solicited.

C. The Beaumont Reference

Beaumont discloses a method for producing gallium nitride epitaxial layer that includes depositing a thin gallium nitride layer 2 having a thickness of 2 μm on a (0001) sapphire substrate 1 having at thickness of 200 μm (col. 5, lines 51-55). After the first epitaxial gallium nitride layer has been grown, a thin layer of a silicon nitride film 3 is deposited as a mask for the subsequent selective growth of gallium nitride (col. 5, lines 62-64). Although extremely thin, this SiN layer proved to be perfectly selective mask, in which photolithography and reactive ion etching are carried out in order to expose hexagonal apertures 4 (col. 6, lines 5-8 and Figs. 1 and 3).

Fig. 3 of Beaumont discloses a sectionalized view perpendicular to the [1120] direction of a localized truncated hexagonal gallium nitride pyramid (col. 6, lines 32-34).

Beaumont asserts that the GaN growth, which takes place laterally in the [1010] directions on a dielectric surface, and therefore without being in epitaxial relationship with the sapphire substrate, results in much better GaN crystal quality (col. 4, lines 26-30).

Claim 32 recites at least the features of "an undercoat layer formed directly on an entirety of said upper surface of said substrate, in which a cross-section of an upper surface of said undercoat layer is characterized by a sectionally trapezoid shape."

Applicant respectfully submits that Beaumont is an improperly cited reference, which cannot be used to establish *prima facie* obviousness, because a modification to Beaumont to read on the present invention would change the principle of operation of Beaumont's invention. Beaumont clearly states that the subsequent selective growth of gallium nitride "without being in epitaxial relationship with the sapphire substrate, results in much better GaN crystal quality." Thus, the invention of Beaumont clearly discloses a mask layer disposed between the thin gallium nitride layer 2 and the subsequent epitaxial growth layer of GaN, which when viewed perpendicularly to the [1120] direction in a cross-section reveals a localized truncated hexagonal gallium nitride pyramid. Therefore, Beaumont teaches away from the feature of "an undercoat layer formed directly on an entirety of said upper surface of said substrate, in which a cross-section of an upper surface of said undercoat layer is characterized by a sectionally trapezoid shape" as recited in claim 32.

As argued above in response to the rejection of claims 2, 3, and 6 under 35 U.S.C.

§103(a) over Sunakawa and Kern, Kern does disclose "an undercoat layer formed directly on an entirety of said upper surface of said substrate" as recited in claim 32. As argued directly above, Beaumont teaches away from "an undercoat layer formed directly on an entirety of said upper surface of said substrate" as recited in claim 32. Accordingly, Beaumont and Kern either individually or in combination fail to render obvious the subject matter of claim 32 and claim 33, which depends from claim 32, under 35 U.S.C. §103(a). Withdrawal of the rejection of claims 32 and 33 under 35 U.S.C. §103(a) as unpatentable over Beaumont in view of Kern is respectfully solicited.

III. CONCLUSION

In view of the foregoing, Applicants submit that claims 1-7, 32 and 33, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: 1/24/03

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend claims 1, 2, 4, 5, 7, 32 and 33 as follows:

1. (Twice Amended) A group III nitride compound semiconductor device, comprising:

a substrate having an upper surface;

an undercoat layer formed directly on an entirety of said upper surface of said substrate [and having a], in which an upper surface of said undercoat layer is covered with convex portions, each of said convex portions being shaped like a truncated hexagonal pyramid; and

group III nitride compound semiconductor layers formed on said undercoat layer and having a device function.

2. (Amended) A group III nitride compound semiconductor device according to claim 1, wherein said undercoat layer [is made of] comprises GaN doped with magnesium.

4. (Twice Amended) A group III nitride compound semiconductor device [according to claim 2], comprising:

a substrate;

an undercoat layer formed on said substrate and having a surface with convex portions each shaped like a truncated hexagonal pyramid; and

group III nitride compound semiconductor layers formed on said undercoat layer and having a device function,

wherein said undercoat layer comprises GaN doped with magnesium and said undercoat layer is also doped with an n-type dopant and is of an [n] n-type as a whole.

5. (Amended) A group III nitride compound semiconductor device according to claim 1, wherein said substrate [is made of] comprises one of sapphire, SiC, and silicon single crystal.

7. (Twice Amended) A group III nitride compound semiconductor device according to claim 1, wherein said group III nitride compound semiconductor layers [have a function of] comprise one of a light-emitting device, a photodetector, and an electronic device as a whole.

32. (Amended) A group III nitride compound semiconductor device, comprising:

a substrate having an upper surface;

an undercoat layer formed directly on an entirety of said upper surface of said substrate [and having a], in which a cross-section of an upper surface [with] of said undercoat layer is characterized by a sectionally trapezoid shape; and

group III nitride compound semiconductor layers formed on said undercoat layer and having a device function.

33. (Amended) A group III nitride compound semiconductor device according to claim 32, wherein the sectionally trapezoid shape includes convex portions, each of said convex portions being shaped like a truncated hexagonal pyramid.